nothing. The use of such an assumption in most cases in the social sciences has usually turned out to be an attempt to explain the known in terms of the less known.

In conclusion, it seems to me that science *as science* may well beware of accepting as yet any universal principle of explanation. It can not accept such until it is demonstrated. The method of science is not, as some philosophers have proclaimed, to build itself up upon some universal assumption. Rather its methods are the pragmatic ones of observation, comparison, testing by experience and measurement. So far as science approaches exactness it is built up by the method of measurement; and many other things than mechanical cause and effect can be measured. It is decidedly premature as yet to say that science will approve any universal principle or method of explanation; and it is decidedly regrettable that any one who works in any of the sciences should, by a narrow definition of scientific method, rule out of the category of scientific works James's "Principles of Psychology" and the whole list of important contributions in the mental and social sciences not based upon the mechanistic assumption.

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"MORE LITTLE BEASTS"

TO THE EDITOR OF SCIENCE: Under the title of "More Little Beasts of Field and Wood," Mr. William Everett Cram, of Hampton Falls, New Hampshire, has given an account of various animals met by him in his walks through the woods, written in a pleasant fashion suggestive of Thoreau, though without Thoreau's touch of moral epigrams.

It is illustrated by a number of fairly correct wood-cuts.

A novel suggestion, at first sight not at all convincing, is this, that the group of hares and rabbits is not an off-shoot from the rodents, but from the family of cats, a rabbit in the long past being a cat, adapted perforce to a vegetable diet. A good many parallelisms between the cats and the rabbits are suggested, among others that cat flesh is sometimes substituted for that of rabbits in the inns of Europe.

DAVID STARR JORDAN

SCIENTIFIC BOOKS

The Horse and its Relatives. By R. LYDEKKER, F.R.S. New York and London, The Macmillan Company. Pp. vi + 286; Pls. XXIV., and 11 text figs. 1912. Price $2.60 net.

This extremely interesting volume is a companion to that on the ox and its kindred by the same author, and summarizes most admirably our knowledge of the members of the equine race, both living and extinct. In the opening chapter the place of the horse in nature is discussed, together with that of its few surviving relatives. The eight or nine species of horses, five of rhinoceroses and five or six of tapirs contrast strikingly with the great number of artiodactyles still living. The perissodactyles are therefore looked upon as a waning race, but the cause of their diminution in numbers is not yet determined.

In discussing the structure of the horse, especial emphasis is placed upon the high degree of specialization of feet and teeth. In the foot the variable degree of reduction of the splint bones is of interest, the great shire horse of England retaining the entire shaft together with remnants of the first and second phalanges of the lateral toes, all firmly welded together, while the Argentine horses show the greatest diminution of these bones. The longheadedness so characteristic of all horse-like forms is a very ancient character and gives space before the eyes for the development of the wonderful dental battery. The pit-like depression in front of the orbit sometimes seen in modern horses is supposed to have lodged a scent gland, of recognition value, similar to that of the deer. The leg callosities known as "chestnuts" are also decadent skin glands. The long columnar teeth with their complex infolding of enamel are admirably adapted to the harsh siliceous grasses which constitute the principal article of diet. They are much more perfect than in the cud-chewing ruminants, in which the food

is subjected to a second chewing at the creatures' leisure, after having been softened in the stomach. In the horse the mastication must be hurriedly and efficiently done once for all.

The coloration of living horses gives rise to the belief that the Arab stock has been derived from a dappled bay, while in the domestic horses of western Europe, probably sprung from a different ancestral species, the primitive hue is dun, the color of withered grass. The tendency toward either melanism (black), erythrism (redness) or albinism (white) gives rise to the various color modifications. Striping is characteristic of all African wild horses, while those of Asia are more uniform.

The occasional presence of rudimentary paired horn-like processes upon the frontal bone, while never showing a corneous covering, is of interest. They are not vestigial, as no equine ancestors show them, and while Lydekker does not suggest it, may they not be indications of approaching racial old age?

Cope's idea that the horse tribe had two independent centers of development from animals of more primitive type, one in the old world and a second in North America, is rejected for that of Matthew, who assumes that "since the horses are represented by a double evolutionary series, one in Europe, a closer one in North America, their center of dispersal lay far enough north to spread into Europe on one hand, North America on the other, but that the latter was nearer or more accessible; *i. e.*, their center of dispersal was northeastern Asia or Alaska."

The wild tarpan or Przevalski's horse, still living on the steppes of Tartary and Mongolia, is the only true horse other than the domestic breeds which has survived. Historical evidences for wild horses in Europe may refer to feral animals, the ancestors of which had escaped from bondage. Prehistoric records, on the other hand, such as the drawings on the walls of caves, show the existence of a small, big-headed horse strongly suggestive of the tarpan. This is the so-called steppe type of Ewart. Two others are also represented by bones and teeth in the Pleistocene of England and the continent, one the plateau type of Ewart, a fine-headed, slender-limbed pony, also depicted in paleolithic art; and the forest type, a long, low horse with short, thick cannon bones and broad hoofs. All three of these are probably races of the modern *Equus caballus* and not separate species.

The author next discusses the domestic horses of the British Isles and some foreign breeds, and their probable origin, including the American feral horses. The latter are derived from those introduced by the Spanish conquerors and are of Barb stock.

Among other living equines the Kiang and Onager group come nearest the true horses. They are Asiatic in distribution, while the asses are apparently from the north of Africa. "It has been stated that 'the ass, and with it its name, accompanied the progress of the culture of the vine and olive to the north, not crossing the limits of that culture. In proportion as the ure-ox, the bison, and the elk died out, the long-eared foreign beast became domesticated in Gaul, receiving various names, and living in the customs, jokes, proverbs, and fables of the people. Germany, however, proved too cold for the animal.'" Asses have become feral in South America. Nearly related to the ass is the true zebra of southern and southwestern Africa, which, together with the now extinct quagga and the bontequagga or Burchell's zebra constitutes the distinctively striped horses of the Ethiopian realm. The curious association of zebras, gnus and perhaps a troop of ostriches to fill up the company, is mentioned, the ostriches apprehending danger through the sense of sight, the others through that of smell. The coloring of zebras, the protective value of which has been so vigorously denied by Colonel Roosevelt, is summarized by the statement that "whatever may be the real truth with regard to some of the disputed points, it is certain that when a zebra enters covert, it becomes, owing to its coloring, indistinguishable."

The final chapter summarizes our knowledge of the extinct forerunners of the horse, the records of which have been so well preserved.

Through each of the five stages—Pleistocene, Pliocene, Miocene, Oligocene and Eocene—of the uppermost eras of geological history we can trace a more or less complete gradation from the horses of the present day to primitive, many-toed animals, scarcely larger than foxes, and presenting few of the features which render the horse and its relatives such a remarkable group. Some idea of the immense lapse of time which has taken place during the slow evolution of the Eocene *Hyracotherium* into the modern *Equus* has been thus expressed by Professor H. F. Osborn, whom Lydekker quotes:

> The Rocky Mountains, it is true, began their elevation during the close of the Age of Reptiles; they had only attained a height of four or five thousand feet when the Age of Mammals commenced; they continued to rise during the entire period. But consider the map of Europe and Asia at the beginning of Eocene time and realize that the great mountain systems of the Pyrenees, the Alps, and the Himalayas were still unborn, level surfaces in fact, partly washed by the sea. . . . The birth of the Pyrenees was at the beginning of the Oligocene. At this time Switzerland was still a comparatively level plain, and not until the close of the Oligocene did the mighty system of the Swiss Alps begin to rise. Central Asia was even yet a plain and upland, and only during the Miocene did the Himalayas, the noblest existing mountain chain, begin to rise to their present fellowship with the sky. In North America, again, since the close of the Eocene the region of the present Grand Cañon of the Colorado has been elevated 11,000 feet and the river has carved its mighty cañon through the rock to its present maximum depth of 6,500 feet.
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> Those who have been impressed with a sense of the antiquity of these wonders of the world, and will imagine the vast changes in the history of continental geography and continental life which were involved, will be ready to concede that the Age of Mammals alone represents an almost inconceivable period of time.

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Electricity and Magnetism for Advanced Students. By SYDNEY G. STARLING. Longmans, Green & Co. 1912. 583 pages, with 452 figures.

This book is the outcome of a number of years' experience in teaching the subject to senior students in an English municipal technical school, and it is a good book. To quote from the preface, it aims "to give such students an adequate knowledge of the present state of the subject, with due reference to the historical sequence of its development, and to the effect of modern research upon it." Its seventeen chapters are devoted to magnetism, terrestrial magnetism, the electric current (2), electrostatics (2), electrolysis, thermoelectricity, electromagnetics, magnetic properties of materials, varying currents, alternating currents, units, electromagnetic radiation, conduction in gases, radioactivity, and electrons. Instruments and methods of measurement receive a great deal of consideration. Each chapter is provided with a number of examples, mostly taken from London B.Sc. and B. of E. papers.

The book follows for the most part conventional lines. Its descriptive matter is clear and full and usually correct. Its mathematical demonstrations are ordinarily sufficiently direct and simple, though it seems to the reviewer that some of them might have been dispensed with and that others, *e. g.*, those pertaining to the Wheatstone and Thomson bridges, would profit by simplification. The calculus is freely used throughout.

As to matters of fact the book is fairly up to date. In many cases, however, important recent contributions receive no mention—such as the use of the methods of electromagnetic induction in terrestrial magnetism, the precise work of Rosa and Dorsey on the ratio of the unit charges, and the brilliant work of Langevin, Weiss and others in the domain of magnetism.

In matters pertaining to fundamental theory the treatment is not always logical and free from looseness. Thus the definitions of electromotive force and potential difference are unsatisfactory; resistivity is defined without reference to the direction of the streamlines; the curl of a vector is defined as its line integral around a closed path; and Gauss's theorem, demonstrated for a homogeneous field only, is assumed without comment to